REMARKS

This Amendment is in response to the Office Action of May 11, 2005 in which claims 1-21 were rejected. With this Amendment, claim 16 is amended. Claims 1-21, as amended are presented for reconsideration and allowance.

Amendment to the Drawings

Please replace FIG. 2 with the replacement sheet enclosed with this Amendment. As shown in the replacement sheet, FIG. 2 has been amended to include the words "Prior Art" as suggested in the Office Action.

Claim Objections

In paragraph 4 of the Office Action, claim 16 was objected to. The claim has been amended to correct the informalities.

Claim Rejections - 35 U.S.C. § 102(e)

In paragraph 6 of the Office Action, claims 1-21 were rejected under 35 U.S.C. § 102(e) as being anticipated by Reinert (USP 6,539,489)("Reinert"). In order to reject a claim under 35 U.S.C. § 102(e) as being anticipated by the prior art, each element of the claim under construction must be disclosed in a single prior art reference. In re Dillon, 919 F.2d 688, 16 U.S.P.Q.2d 1897, 1908 (Fed. Cir. 1990)(en banc), cert. denied, 500 U.S. 904 (1991).

Rejected claims 1-5

The Office Action rejected independent claim 1 by stating that Reinert discloses a method for time synchronization of field devices on a network of a distributed control system that includes each and every limitation of claim 1. The present invention, however, differs from Reinert in terms of how the signal

adjustment is performed and the resulting signal output. In particular, the difference is that Reinert does not disclose the "adjusting an output clock signal frequency" limitation of independent claim 1.

The present invention synchronizes device clocks by using timing information to adjust the frequency of the output clock. The purpose is to synchronize the clock rates or frequencies of the time slave device 18 with the clock rate of the time master 16 on the network segment. Adjusting the frequency changes the long-term rate of the clock (page 10, lines 3-22).

To change the rate of the clock signal, a scaling factor is used (page 3, lines 5-19). The scaling factor is determined by calculating a frequency ratio, which is the rate of the time master 16 clock signal over the rate of the time slave 18 signal (page 12, lines 13-18). The frequency ratio shows whether the local reference clock of slave device 18 has a faster or slower rate when compared with the clock of the time master 16. The ideal frequency ratio is 1.0, which indicates that the clocks are at the same rate (page 12, lines 13-25). A frequency ratio greater or less than the ideal of 1.0 indicates that the two clocks are running at different frequencies. The boundary conditions to determine if an adjustment is necessary is whether the frequency ratios are within an acceptable deviation (page 12, lines 13-25). If the frequency ratio is not within the acceptable deviation, a scaling factor is applied to the clock rate, which has the effect of changing the long-term rate of the signal (page 12, line 20 to page 13, line 8; and page 10, lines 3-22). The frequencies do not focus on whether the phases of the clocks are aligned.

In contrast, Reinert discloses a method of synchronization that performs adjustment through phase compensating or time shifting the output clock (col. 6, line 53 to col. 7, line 23). In other words, Reinert focuses on synchronizing the slave event start pulse with the master event start pulse, rather than performing synchronization through adjusting the rate or frequency of the slave clock signals (col. 7, lines 10-23). The phase of a clock is shifted such that the start pulse of the clock occurs within a specific interval (col. 6, lines 49-52). The phase shift is accomplished by using adjustment variables that indicate the amount of shifting needed for a signal to fall within an acceptable interval (col. 6, lines 53-64). Reinert discloses

nothing about adjusting the frequency or rate of the clock. When phase shifting or time shifting a signal, the frequency or long-term rate remains the same.

Because Reinert fails to disclose this element of independent claim 1, the rejection of claim 1 under 35 U.S.C. § 102(e) should be withdrawn. Claims 2-5 depend from independent claim 1, and also are allowable.

Rejected claims 6-11

The Office Action rejected independent claim 6 by stating that Reinert discloses a method for synchronizing a local sense of time of each of a plurality of field devices on a segment of a control network using a time distribution unit that includes each and every limitation of claim 6.

One limitation of claim 6 is "calculating a frequency ratio between the local sense of time of a field device and a sense of time of the master field device." The Office Action stated that this limitation is disclosed by the generation of a time interval in Reinert (FIG. 1B, block 340; and col. 7, line 66 to col. 8, line 25). This interpretation of Reinert and the present invention is inaccurate. The present invention calculates the frequency ratio by dividing the rate of the time master 16 clock signal over the rate of the time slave 18 signal (page 12, lines 13-18). The frequency ratio indicates whether the rate of the time slave 18 signal is within an acceptable range of the rate of the time master 16 clock signal (page 12, line 20 to page 13).

In contrast, Reinert discloses a time interval or window T_{int} 44. T_{int} 44 is represented "by the minimum time T_{min} 41, the actual time T_{act} 42 and the maximum time T_{max} 43." (Col. 8, lines 6-8). T_{int} 44 does not represent the acceptable range of the rate or frequency of the field device. Rather, T_{int} 44 "represents the maximum phase or timing error that may be acceptable . . . ." (Col. 8, lines 2-4). In other words, T_{int} 44 is a guide for how much the signal of the time slave 18 signal must be shifted such that the phase corresponds to the time master 16 signal phase. T_{int} 44 is not a guide for how much to adjust the long-term rate or frequency of the time master 16 signal.

Another limitation of claim 6 is "adjusting as necessary the sense of time of the field device according to the frequency ratio." The Office Action stated that this limitation is disclosed in Reinert by the phase shifting of the signal such that the signal is within T_{int} 44 (FIG. 1B, blocks 360 and 370; and col. 8, line 63 to col. 9, line 30). The present invention uses the frequency ratio, which is based on the signal rates of the master and field devices, to calculate scaling factors to adjust the frequency or rate of the time slave 18 signal (page 3, lines 5-19). Adjusting the frequency of a signal changes its long-term rate (page 10, lines 3-22).

In contrast, Reinert does not adjust the long-term rate of a signal based upon a frequency ratio. Rather, Reinert discloses a method of phase shifting a field device signal such that the phase occurs within a window of time (FIG. 1B, blocks 360 and 370; and col. 8, line 63 to col. 9, line 30).

Because Reinert fails to disclose all the elements of independent claim 6, the rejection of claim 6 under 35 U.S.C. § 102(e) should be withdrawn. Claims 7-11 depend from independent claim 6, and also are allowable.

Rejected claims 12-17

The Office Action rejected independent claim 12 by stating that Reinert discloses a process control system having a common sense of time that includes each and every limitation of claim 12. One limitation of claim 12 is "a time adjustment element for adjusting the local clock according to a frequency ratio between the master signal and an output clock signal of the local clock." The Office Action stated that this time adjustment element is disclosed by the phase regulator (FIG. 2, element 80) or the synchronization control and processor module (FIG. 4, element 660). Also, the Office Action stated that the adjusting of the local clock according to a frequency ratio was disclosed by the hardware or software used to phase compensate or time shift the signal of the local clock (col. 6, lines 40-52 or col. 7, line 41 to col. 9, line 30).

The present invention as defined by claim 12 differs from Reinert. As discussed above, the present invention uses the frequency ratio, which is based on the signal rates of the master and field

devices, to calculate scaling factors to adjust the frequency or long-term rate of the time slave 18 signal (page 3, lines 5-19 and page 10, lines 3-22).

In contrast, Reinert does not adjust the long-term rate of a signal based on a frequency ratio. Rather, Reinert discloses a method phase shifting a field device signal such that the phase occurs within a window of time (FIG. 1B, blocks 360 and 370; and col. 8, line 63 to col. 9, line 30).

Because Reinert fails to disclose all the elements of independent claim 12, the rejection of claim 12 under 35 U.S.C. § 102(e) should be withdrawn. Claims 13-17 depend from independent claim 12 and also are allowable.

Rejected claims 18-21

The Office Action rejected independent claim 18 by stating that Reinert discloses a method for reducing time processing cycles in distributed field devices of a process control network that includes each and every limitation of claim 18. One limitation of claim 18 is "calculating adjustment coefficients for each field device according to a difference in frequencies between a local clock of each field device and a master clock on the process control network." The Office Action stated that this limitation is disclosed by the generation of a time interval or window T_{int} 44 "which represents the maximum phase or timing error that may be acceptable for a particular application of the master-slave asynchronous communication system 200." (FIG. 1B, block 340; and col. 7, line 66 to col. 8, line 25).

The present invention calculates adjustment coefficients for each field device according to the difference in frequencies or rates between a local clock and a master clock (page 9, lines 11-26). The coefficients are used to adjust the frequency or rate of the local clock (page 9, line 27 to page 10, line13). As noted in the disclosure, the variable clock 34 used to adjust the frequency is a variable speed hardware clock (page 10, line 3-13). In other words, the variable clock 34 is used to adjust the long-term rate of the signal.

In contrast, Reinert discloses a timer interval generating system that calculates T_{int} 44, which corresponds to the maximum phase or timing error (col. 7, line 66 to col. 8, line 25). T_{int} 44 indicates

whether the phase of the local clock is within an acceptable range of the phase of the master clock (col. 7, line 66 to col. 8, line 25). Any difference corresponds to the clock "jitter" (col. 8, lines 8-22). The "jitter" is not a difference in frequency or rate, but indicates whether the local and master clock are in-phase or out-of-phase with each other (col. 8, lines 8-22). The method used to correct the out-of-phase local clock signal is not to adjust the frequency or rate of the local clock signal, but to phase compensate or time shift the signal so that it occurs within T_{int} 44.

Because Reinert fails to disclose all the elements of independent claim 18, the rejection of claim 18 under 35 U.S.C. § 102(e) should be withdrawn. Claims 19-21 depend from independent claim 18 and are allowable therewith.

In conclusion, this Amendment has placed the application in condition for allowance. Notice to that effect is requested.

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AMENDMENTS TO THE DRAWINGS

Please replace FIG. 2 with the replacement sheet enclosed with this amendment.